REMARKS

Claims 13-22 currently appear in this application. The Office Action of January 24, and the Advisory Action of March 8, 2006, have been carefully studied. These claims define novel and unobvious subject matter under Sections 102 and 103 of 35 U.S.C., and therefore should be allowed. Applicant respectfully requests favorable reconsideration, entry of the present amendment, and formal allowance of the claims.

Indefinite

Claims 13-14 and 17-21 are said to be indefinite because of the phrase "optionally."

If this is a rejection, this rejection is respectfully traversed. Submitted herewith is a copy of results of a search through the USPTO full-text and image database for patents having the word "optionally" in the claims. According to the results of this search, there are 53,882 patents that have the word "optionally" in the claims.

In the present case, it is quite clear which limitations are part of the claimed invention. Using claim 13 as an example, the combination claimed comprises:

(a) a first film of flexible resin material, wherein said first film of flexible resin

> material is optionally water impermeable or is optionally coated with a water-impermeable material.

This means that the first film is optionally water-impermeable or is optionally coated with a water-impermeable coating. That is, the first film is optionally water-impermeable.

> (b) a second film of flexible resin material, wherein said second film of flexible resin material is optionally water-impermeable or is optionally coated with a water-impermeable material…

This clearly means that the second film is optionally water impermeable or is optionally coated with a water-impermeable coating. That is, the second film is optionally water-impermeable.

This type of alternative claim language has long been accepted by the USPTO, as evidenced by the more than 63,000 patents that have issued having "optionally" in the claims. Moreover, MPEP Section 2173.05(h) III specifically states that the term "optionally" is acceptable alternative language if there is no ambiguity. In *Ex Parte Cordova, 10 USPQ2d 1949* (Bd. Pat. App. & Inter. 1989), the language "containing A, B and optionally C" was considered acceptable

alternative language because there was no ambiguity as to which alternatives are covered by the claims. In the present case, the description of the first film is separated from the description of the second film by a paragraph break, and the description of the second film is separated from paragraph (c) by a paragraph break, making it clear that "optionally" only applies to the description in the individual paragraph in which the word appears. That is, each film is "optionally" water-impermeable. It is clear from this language what is covered by the claims.

Allowable subject Matter

In the Office Action of August 8, 2005, Examiner Johnson proposed a claim that he said would be allowable. Claim 22, with the addition of the recitation" shock-attenuating", was presented in an amendment filed November 14, 2005. It is not understood why this claim was not deemed to be allowable after the Examiner had suggested such a claim.

Art Rejections

The claims have been amended to recite that the assembly is a shock-attenuating assembly in order to make it even more clear that this invention is related to shock/blast absorption. Support for this amendment can be found throughout the specification, most notably at paragraphs 16-

18, paragraph 17 specifically states, "The assembly of the present invention is a highly efficient at rapidly attenuating high pressure shock waves, *i.e.*, blast." It is respectfully submitted that this does not constitute new matter or raise new issues, as claims 13-22 as filed recited that each of the pockets is filled with a shock wave terminating material. Thus, it is self-evident that the assembly as claimed has always been a shock-attenuating material.

In *Corning Glass Works v. Sumitomo Electric U.S.A.*, 868 F2d 1251, 9 USPQ2d 1962 (Fed. Cir. 1989), the court noted that "To read the claim in light of the specification indiscriminately cover all types of optical fibers would be divorced from reality. The invention is restricted to those fibers that work as waveguides as defined in the specification." (at 1257, 1966). This is analogous to the present situation, in which the claims are directed to a ballast-attenuating assembly. The shock-attenuating assembly requires the presence of shock attenuating material. It is respectfully submitted that none of the cited references deals with shock attenuation, and, therefore, that these cited references are irrelevant to the present case.

Submitted herewith is a discussion of the effects of blast overpressure on the human body, with reference to explosion resistant trash receptacles authored by Kevin J.

Sharpe. This is a discussion of how the flexible assembly of the present invention can be used to line a trash receptacle and thus mitigate damage caused by a bomb blast.

Claims 13 and 17-22 are rejected under 35 U.S.C. 102(b) as being anticipated by Colle.

This rejection is respectfully traversed. Colle has nothing to do with blast attenuation, but rather discloses a form for erosion control. Contrary to the Examiner's assertion that Colle discloses a shock wave attenuating material, it is clear from reading column 4, lines 23-42, that Colle discloses that any suitable material which is used which can flow into the form and fill the entire space. Examples of such materials include any of the various conventionally known cementitious slurries, which can harden when disposed under a body of water; or various forms of commercially available flowable asphalts. While these materials may **initially** be flowable, they must eventually **harden**. In contrast thereto, the flowable material of the present invention must remain in flowable form in order to mitigate blasts.

The assembly of the present invention is for blast mitigation, that is, shock attenuation. When wind form a blast gets into the assembly of the present invention, the shock wave attenuating material interacts with the fireball formed by the blast as well as with pressures from the blast.

If the contents of the assembly were solid, as in Colle, it would have no effect on either the fireball or the blast. The assembly would become a projectile, such as a piece of steel. If the assembly were filled with water, it would not act as a mitigating material but it would behave like a tsunami, and the force of the water would become a killer itself.

Claims 13 and 17-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Munch in view of Colle.

As noted above, Colle fills the pockets with a flowable material that hardens. Contrary to the Examiner's assertions, Munch does not disclose a shock wave attenuating material at column 3, lines 40-67. Munch specifically states that the filling 2 of packs 1 **comprises a substantially non-flowable mixture of water, glycol, salt and finely dispersed silicic acid**. The assembly claimed herein is filled with a shock wave attenuating material having the flow properties of a liquid. Moreover, neither of these patents discloses or suggests an assembly for shock attenuation.

Claims 13 and 17-22 are rejected under 35 U.S.C. 102(b) as being anticipated by Poux.

This rejection is respectfully traversed. Poux discloses a combination ice and hot pack, which is clearly not designed for shock attenuation. At column 4, line 7, Poux discloses that the compartments contain a liquid. Poux says

nothing about shock absorption or attenuation, and does not disclose or even suggest a shock wave attenuating material.

Claims 13, 17, 18 and 20-22 are rejected under 35 U.S.C. 102(b) as being anticipated by Herran.

This rejection is respectfully traversed. Herran discloses a flexible package filled with products which are to be stored separately from each other. This device has nothing at all to do with shock attenuation. In fact, one would not subject this package to a shock wave, because the film might break and cause the products which are to be stored separately from each other to come in contact with each other. Merely because the Herran package can be used with liquids, solids, gels, and combinations of materials in different forms can hardly anticipate use of a shock wave attenuating material.

Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Herran in view of Symons.

This rejection is respectfully traversed. As noted above, Herran has nothing at all to do with shock absorption, and there is nothing in Herran that even suggests the packaged material would be perlite. Symons discloses a panel, not a flexible assembly, that may contain perlite **as an insulating material**. There is nothing in either of Symons or Herran that would lead one skilled in the art to place a shock attenuating material such as perlite into a package as disclosed by

Herran, particularly since the Herran package is designed to keep two different products separate from one another.

Evidence of Long-Felt Need and Commercial Success

The Supreme Court held in *Graham v. John Deere Co.* 383 U.S. 1 (1966) that secondary considerations such as commercial success, long felt but unsolved needs, failure of others, etc. might be used to give light to the circumstances surrounding the origin of the subject matter to be patented. As indicia of obviousness or nonobviousness, these inquiries may have relevancy.

Judge Learned Hand, in *Safety Car Heating & Lighting Co. v. General Ele. Co.*, 155 F2d 937, 939, 69 USPQ 401, 402 (2d Cir. 1946), viewed "the length of time the art, though needing the invention, went without it" as the best nontechnical guidepost for inferring nonobviousness. Judge Hand also thought evidence of commercial success important primarily as an adjunct to the test of long-felt need, *Textile Mach. Works v. Louis Hirsch Textile Mach.*, 87 E2d 702, 704, 32 USPQ 471 (2d Cir. 1937), aff'd, 302 U.S. 490 (1938).

Evidence of commercial success can be seen in the declaration of James Gordon, one of the present inventors, submitted herewith.

Evidence of long-felt need is well known to anyone familiar with the World Trade Center bombing in 1993 and the

Oklahoma City federal building bombing of 1995. Additionally, the United Kingdom has suffered for years from IRA bombs planted in densely populated areas, as evidenced by the description of "The Troubles", Principal Events, submitted herewith. Beginning December 4, 1971, when Protestant terrorists killed 15 Catholics with a bomb in a Londonderry bar, through January 10, 1992, when a bomb in Whitehall damaged government buildings, there has been a need for blast mitigation to attenuate the effects of these terrorist bombs. More recently, in October of 2005, an IRA bomb was used in Iraq to kill eight British soldiers.

To date, there have been no solutions to the problem of bombs dropped into receptacles in crowded areas that then are detonated and do significant damage to innocent bystanders. Thus, there has been a long-felt need for some type of protection for receptacles and the like, which the flexible assembly of the present invention can provide.

In view of the above, it is respectfully submitted that the claims are now in condition for allowance, and favorable action thereon is earnestly solicited.

Respectfully submitted,

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	PAT. NO.	Title
1	6,996,474	Automated method for identifying related biomolecular sequences
2	6,996,466	Method of controlling vehicle handling by influencing the yaw velocity
3	6,995,825	Process for preparing films of polymerized liquid crystal material having a first film of a polymerized liquid crystal material with uniform orientation and a second film of a polymerized liquid crystal material with uniform orientation directly on the first film
4	6,995,291	Process for the oxidation of unsaturated alcohols
5	6,995,286	Process for preparing isomers of salbutamol
6	6,995,285	ABCA-1 elevating compounds
7	6,995,283	Benzophenones as inhibitors of reverse transcriptase
8	6,995,280	Process for preparing (mercaptoorganyl)alkoxysilanes
9	6,995,278	Antiangiogenic agents
10	6,995,276	Cyclic disulfide compound, process of producing the same and optical product comprising the same
11	6,995,275	Production of N-aryl-2-lactam and N-alkyl-2-lactam by reductive amination of lactones with aryl and alkyl nitro compounds
12	6,995,274	Cyanine dyes
13	6,995,271	Production method of isoxazolidinedione compound
14	6,995,270	Hydrogenation process
15	6,995,263	Indolyl and dihydroindolyl derivatives, their manufacture and use as pharmaceutical agents
16	6,995,262	Use of acylsulfonamido-substituted polymethine dyes as fluorescene dyes and/or markers

17 6,995,247 Ac-HEHA and related compounds, methods of synthesis and methods of use
18 6,995,231 Extrudable highly crystalline thermoplastic polyurethanes
19 6,995,230 Stabilizers, in particular for thermoplastic polyurethanes
20 6,995,227 Activator compositions for cyanoacrylate adhesives
21 6,995,223 3,4-alkylenedioxy-thiophene copolymers
22 6,995,210 Aqueous dispersion based on viscous silicone oils crosslinkable by condensation into an adhering elastomer for use in particular as sealants or paints, preparation method
23 6,995,194 Radiation curable powder coating compositions
24 6,995,185 Δ1-pyrrolines used as pesticides
25 6,995,184 3-arylindole derivatives and their use as CB_2 receptor agonists
26 6,995,183 Adamantylglycine-based inhibitors of dipeptidyl peptidase IV and methods
27 6,995,181 Modulators of the glucocorticoid receptor and method
28 6,995,180 Glycinenitrile-based inhibitors of dipeptidyl peptidase IV and methods
29 6,995,178 Insecticidal anthranilamides
30 6,995,177 HCV NS3 protease inhibitors
31 6,995,176 1-heterocyclylalkyl-3-sulfonyl-indole or -indazole derivatives as 5-hydroxytryptamine-6 ligands
32 6,995,175 Chemical derivatives and their application as antitelomerase agent
33 6,995,174 Hepatitis C virus inhibitors
34 6,995,171 Bicyclic pyrimidine and pyrimidine derivatives useful as anticancer agents
35 6,995,170 Semi-hydrochloride of 8-cyano-1-cyclopropyl-7-(1S,6S-2,8-diazabicyclo[4.3.0]nonan-8-yl)-6-fluoro-1, 4-dihydro-4-oxo-3-quinolinecarboxylic acid
36 6,995,167 Arylkylamine spirofuropyridines useful in therapy
37 6,995,163 Tricyclic fused heterocyclic compound, process for preparing it and medicament comprising it
38 6,995,162 Substituted alkylamine derivatives and methods of use
39 6,995,161 Substituted arylpyrazines
40 6,995,159 5-HT receptor ligands and uses thereof
41 6,995,155 Benzodiazepine derivatives as inhibitors of gamma secretase
42 6,995,154 Heterocyclic topoisomerase poisons
43 6,995,151 Isophthalic acid derivatives as matrix metalloproteinase inhibitors
44 6,995,142 Antipicornaviral compounds and compositions, their pharmaceutical uses, and materials for their synthesis
45 6,995,139 Cyclic undecapeptide pro-drugs and uses thereof
46 6,995,136 Peptide fragments of murine epidermal growth factor as laminin receptor targets
47 6,995,124 Methods for laundering delicate garments in a washing machine
48 6,995,122 Method for imparting substantive fragrance and, optionally, anti-static properties to fabrics during washing and/or drying procedure and compositions useful for effecting such processes
49 6,995,113 Catalysts which are based on organic-inorganic hybrid materials containing noble metals and titanium and which are used for selectively oxidizing hydrocarbons
50 6,995,110 Complex catalyst, process for producing the complex catalyst, and process for producing alcohol derivative with the complex catalyst

Discussion of the Effects of Blast Overpressure on the Human Body With Reference to Explosion Resistant Trash Receptacles

Kevin J Sharpe

BlastGard International, Inc.

Executive Summary

Increasingly spectacular statements are being made by several manufacturers of blast resistant trash receptacles where it is claimed that their products can protect against explosive threats. Threats as large as 10lbs (4.54Kgs) of high explosive, and such claims are becoming commonplace. These claims are misleading and place the public at significant risk in the event of an explosion. What the claims actually refer to is that the blast resistant bin **doesn't come apart, or fragment** under the explosive loading from a large (usually centrally placed) internal detonation. Protecting against an explosive event of this magnitude is a far more challenging task than merely ensuring that the receptacle remains intact.

If a trash receptacle is to offer comprehensive protection from an explosion to the public the following four threats have to be addressed:

- Primary fragmentation from material in contact with the explosive (like a pipe bomb)
- Secondary fragmentation from material close to the explosive (usually the bin itself)
- Blast pressure
- Thermal/Fireball

This discussion examines the threats posed to the public from explosions within trash receptacles and offers insight into the physiological damage that such an event may cause to the human body.

There are currently no guidelines available in the US for manufacturers of **blast resistant trash receptacles** (trash receptacles that dramatically reduce the hazardous effects to the public from an internal explosion) and there are no accepted standards for testing or certification. This note proposes that this may be an opportune moment for the discussion on standards, testing and certification to begin. An attempt at defining such a standard is included.

Introduction

The problem in dealing with all four of the threats has been approached by BlastGard International, Inc. and its partner, Centerpoint Manufacturing, Inc. from two perspectives; the first is an awareness of the practicalities of developing a trash receptacle that can withstand the detonation of a large explosive charge and the second is a development of a technology that can dramatically reduce the threat to the public from the threats from blast pressure and thermal/fireball. BlastGard International's product BlastWrap™ has been developed specifically to extinguish the fireball in a few milliseconds and to dramatically reduce blast pressures. The experience and expertise to evaluate the effects of these phenomena on the human body and also on structures is essential if the

implications are to be understood.

My background is in explosive engineering, the measurement and mitigation of blast in improvised explosive device (IED) disposal scenarios and the evaluation of vulnerabilities in structures and systems. I worked for the UK Ministry of Defence for over 24 years, until recently when I joined the BlastGard International team.

The Threat

Correct identification of the threats that a system has to survive is crucial to the successful design of an effective solution. A clear understanding of what is required of a system is also crucial. If a proposed solution to a threat concentrates in just one area ignoring the other more challenging threats, then the solution will be ineffective.

The most common terrorist threats, as seen through out the world, have been:

- Steel pipe bomb filled with ½ lb of smokeless powder.
- Small TNT bare charges.
- Nut, bolt and nail-laden explosives charges.

This experience has been rudely shaken by recent events on the underground rail system in London. It can be seen that terrorists are planning to kill and maim large numbers of people and are using increasingly large explosive charges. The charge sizes used in the London bombings has been estimated to be around 10lbs of TNT equivalence.

It is relatively easy and inconspicuous to drop a small package containing an IED into a trash receptacle. Upon detonation, an "unhardened" trash receptacle becomes part of the threat by fragmenting into many potentially lethal pieces, much like a grenade.

However, a ten pound high explosive charge is not so easily deposited. If formed into a sphere, it would have a diameter of seven inches and when combined with a timing and power unit (TPU), shrapnel and packaging, it would be relatively bulky (in fact the devices used in London were carried and deployed in backpacks). Depositing such a bulky package into a litterbin is an unusual act and may draw attention but is not beyond what is possible and so we regard the maximum credible charge size that may be placed in a trash receptacle as being ten pounds TNT equivalent or less.

Managing the Threat

There are four distinct aspects of an IED explosion inside a trash receptacle that need to be managed effectively if members of the public in the surrounding area

are to avoid injury. These are:

- Primary fragmentation from the casing of the device or materials in contact with the explosive charge.
- Secondary fragmentation from the break up of the trash receptacle under explosive loading, or from the acceleration of adjacent articles in the trash receptacle
- Air blast pressure
- Thermal/fireball effects

Any blast resistant trash receptacle must stop the primary fragmentation from escaping as this is the most immediate and potentially lethal threat to the public. The bin also must not come apart under explosive loading, potentially generating secondary fragmentation and adding to the lethality of the device. In addition to these two criteria, it is essential that the air blast pressure, blast flash and thermal/fireball output are effectively managed. Each one of these can be as damaging or lethal as is fragmentation. **A bin that is designed merely to not come apart, but that does not mitigate the explosion, will funnel the blast and fireball out of the open end much like a cannon. This focusing effect can have catastrophic consequences for people, buildings and structures.** To illustrate the fact that blast must be managed if the threat to life and limb is to be reduced as far as is possible, the following paragraphs describe the effects of blast on the human body.

Patho-physiology of Blast Injuries

Traditionally, blast injuries are divided into four categories: primary, secondary, tertiary, and miscellaneous injuries. A patient may be injured by more than one of these mechanisms.

- A primary blast injury is caused solely by the direct effect of blast overpressure on tissue. Air is easily compressible, unlike water. As a result, a primary blast injury almost always affects air-filled structures such as the lung, ear, and gastrointestinal (GI) tract.
- A secondary blast injury is caused by flying objects that strike people.
- A tertiary blast injury is a feature of high-energy explosions. This type of injury occurs when people fly through the air and strike other objects.
- Miscellaneous blast-related injuries encompass all other injuries caused by explosions. For example, the collision of two jet airplanes into the World Trade Center created a relatively low-order pressure wave, but the resulting fire and building collapse killed thousands.

The patient's location relative to the center of an explosion is a critical factor in determining the extent and severity of the injuries sustained.

- An explosion that occurs in an enclosed space (including a building, mine, or a relatively lightly constructed enclosed space such as a bus) or in water tends to cause more serious injury.
- Intensity of an explosion's pressure wave declines with the cubed root of the distance from the explosion. A person 3 m (10 ft) from an explosion experiences 9 times more overpressure than a person 6 m (20 ft) away. Proximity of the person to the explosion is an important factor in a primary blast injury.
- Blast waves are reflected by solid surfaces; thus, a person standing next to a wall or in a corner will likely suffer significantly increased primary blast injury. Reflected blast pressures can be as much as 8 times the intensity of the original. Explosions inside buildings and others structures can produce highly complex and unpredictable blast hazards.

The primary causes of blast injury are as follows:

- The direct effect of blast overpressure on tissue. Since air is easily compressible by pressure while water is not, this overpressure almost always affects air-filled structures.
- Pulmonary barotrauma (damage to the lungs caused by pressure) which is the most common fatal primary blast injury. This includes pulmonary contusion, systemic air embolism, and free radical–associated injuries such as thrombosis, lipoxygenation, and disseminated intravascular coagulation (DIC). Acute Respiratory Distress Syndrome (ARDS) may be a result of direct lung injury or of shock from other body injuries.
- Acute gas embolism (AGE), a form of pulmonary barotrauma, requires special attention. Air emboli most commonly occlude blood vessels in the brain or spinal cord. Resulting neurological symptoms must be differentiated from the direct effect of trauma.
- Intestinal barotrauma is more common in underwater explosions than in air blasts. Although the colon usually is affected most, any portion of the GI tract may be injured.
- The ear is the organ most susceptible to primary air blast injury. Acoustic barotrauma commonly consists of tympanic membrane (TM) rupture, or burst eardrum. Hemotympanum (bleeding of the eardrum) without perforation also

has been reported. Ossicle fracture (of a small bone in the inner ear) or dislocation may occur with very high-energy explosions.

The secondary causes of blast injury are:

- Injuries caused by flying objects striking individuals.
- These secondary mechanisms are responsible for the majority of casualties in many explosions. For example, the glass facade of the Alfred P. Murrah Federal Building in Oklahoma City shattered into thousands of heavy glass chunks that were propelled through occupied areas of the building with devastating results.
- Military explosive casings (e.g. hand grenades) are specifically designed to fragment and to maximize damage from flying debris (shrapnel).
- Civilian terrorist bombers (e.g. Olympic Park in Atlanta) often deliberately place screws or other small metal objects around their weapons to increase secondary blast injuries.

The tertiary causes of blast injury

- These injuries are caused by individuals flying through the air and striking other objects, generally from high-energy explosions.
- Unless the explosion is of extremely high energy or focused in some way (e.g. through a door or hatch), a person with tertiary blast injury usually is very close to the explosion source.
- Together with secondary blast injuries, this category accounted for most of the pediatric casualties in Oklahoma City. There was a high incidence of skull fractures (including 17 children with open brain injuries) and long-bone injuries including traumatic amputations.

Miscellaneous blast-related injuries (other injuries generated by the explosion) are caused by the following:

- Toxic inhalations and exposures, radiation exposure, burns (chemical or thermal)
- Asphyxiation in fires (including carbon monoxide [CO] and cyanide [CN] poisoning following incomplete combustion), and dust inhalation, including coal and asbestos exposure
- Crush injuries from collapsed structures and displaced heavy objects

Mortality/Morbidity

- Mortality rates vary widely. Injury is caused both by direct blast overpressure (primary blast injury) and by a variety of associated factors.
- Mortality is increased when explosions occur in closed or confined spaces (e.g. terrorist bus bombings) or under water. Land mine injuries are associated with a high risk of below- and above-the-knee amputations. Fireworks-related injuries prompt an estimated 10,000-12,000 ER visits in the United States annually, with 20-25% involving either the eye or hand.
- Presence of tympanic membrane (TM) rupture indicates that a high-pressure wave (at least 6 psi or 40 kPa) was present and may correlate with more dangerous organ injury. Theoretically, at an overpressure of 15 psi or 100 kPa (the threshold for lung injury, TM routinely ruptures; however, a recent Israeli case series of 640 civilian victims of terrorist bombings contradicts traditional beliefs about a clear correlation between the presence of TM injury and coincident organ damage. Of 137 patients initially diagnosed as having isolated eardrum perforation who were well enough to be discharged, none later developed manifestations of pulmonary or intestinal blast injury. Furthermore, 18 patients with pulmonary blast injuries had no eardrum perforation.

Blast Injury Threshold

The case of ten pounds (4.54Kg) of TNT equivalence detonated inside a litter bin is now considered. Ten pounds of TNT liberates on detonation around 19 million Joules (MJ) of energy. This is a huge amount of energy to dissipate in a few thousandths of a second. Some blast resistant trash receptacle manufacturers claim that energy is taken out of the blast by the deformation of the receptacle. Simple calculation shows that deformation of the steel bin will only account for a tiny portion of the 19 MJ available. The remainder of the energy will either be transmitted through the sides as a shock or vented out through the open end. It is misleading, as some manufacturers suggest, that the blast is "directed up away from the people, and not outwards". **This is plainly not true.** While the blast is initially focussed upwards out of the open mouth of the bin, the pressure wave will expand to equalize the pressure on either side of the shock wave and begin to spread outwards spherically immediately upon exiting the bin. On impacting with the ground surrounding the receptacle the blast wave will be reflected from the surface and ***it will establish itself as a stable, hemispherical blast wave, very similar to that generated by a 10lb charge detonated in free air.*** Tests conducted at Bakersfield, California have shown exactly this. The reduction in blast pressure by detonation of the charge inside an unmitigated trash receptacle is minimal.

As shown in the tests for a charge as large as 10lbs, the effects of the bin will be negligible on the overpressure developed. Scaling of the 10lb charge gives the

following estimations of pressures and physiological impact on the human body:

Distance from Bin	Injury to 70Kg Human
9 feet	Severe burns
17 feet	Onset of lung damage
18 feet	First degree burns
28 feet	All eardrums burst
43 feet	Onset eardrum rupture
98 feet	Completely safe

It should be noted that these figures are for <u>free field</u> hemispherical blasts. The possibility of injury will be significantly increased where there are complex reflections, as in the case of an explosion inside a building. The data given in the table above has been assembled from a number of different sources notably Paul Coopers "Explosive Engineering" and from the graph shown below obtained from the Journal of Mine Action website (http://maic.jmu.edu/journal/4.2/Focus/Bass/bass.htm).

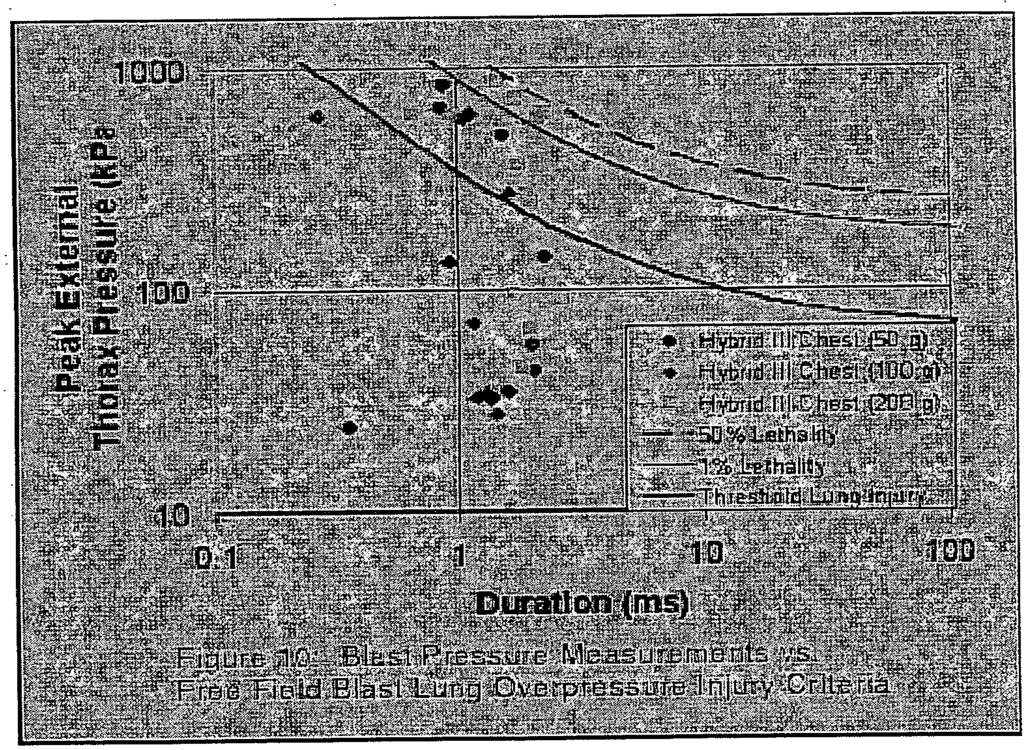

Fig 1: Pressure/duration data for the onset of blast injury

It can be seen from the data in the table that if substantial mitigation of the blast is not provided, an important part of the threat from an IED detonated internally in a trash receptacle will not be managed effectively. The following photographs give an indication of the kind of crowded environments in which trash receptacles are normally deployed. It is instructive to consider the data on blast injury given above when referring to the photos.

Fig 2: Airport concourse "sterile" area.

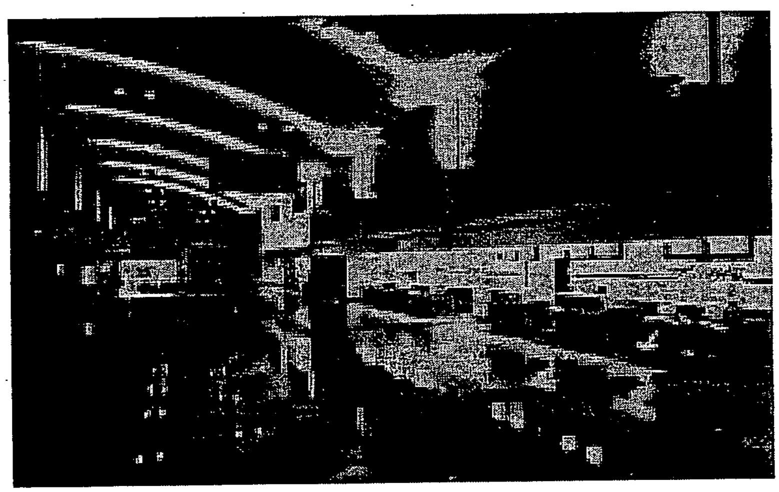

Fig 3: Airport concourse "non sterile" area

Fig 4: Subway platform

Trash receptacles are deployed in areas of high footfall, often inside structures, where the blast environment is complex and multiple reflections will form. This is likely the worst in-air scenario for blast injuries.

The answer to the conundrum of blast resistant trash receptacle placement may lie in the choice of charge size, against which the public can be claimed to be safely protected. Charge sizes of 10lb are simply not manageable in scenarios where people regularly approach within a few feet of the target bin unless the blast and fireball are dramatically reduced. The following table considers the implications for reducing the charge size on blast overpressure and fireball in relation to human physiological injury:

For 6lbs TNT

Distance from Bin	Injury to 70Kg Human
7.4 feet	Severe burns
14.5 feet	Onset of lung damage
15 feet	First degree burns
24 feet	All eardrums burst
36 feet	Onset eardrum rupture
83 feet	Completely safe

For 3lbs TNT

Distance from Bin	Injury to 70Kg Human
6.3 feet	Severe burns
11 feet	Onset of lung damage
12 feet	First degree burns
19 feet	All eardrums burst
29 feet	Onset eardrum rupture
65 feet	Completely safe

For 1lb TNT

Distance from Bin	Injury to 70Kg Human
5 feet	Severe burns
8 feet	Onset of lung damage
10 feet	First degree burns
13 feet	All eardrums burst
20 feet	Onset eardrum rupture
46 feet	Completely safe

It can be seen that if the charge size is lowered to 3lb the damaging blast radius is reduced, but not significantly; and, the risk of serious injury still remains. What is significant is the reduction in blast pressures inside the trash receptacle. The opportunity for energy absorption by plastic deformation of the receptacle wall and blast mitigation applied internally to mitigate the blast pressure is dramatically improved. Ultimately, the effectiveness of this approach can only be quantified by testing and evaluation.

Structural damage from an internal blast is also a significant issue that must be addressed. The top of a litter bin in the top photograph of Fig 2 would be approximately 8 feet (2.46m) from the ceiling. For a 10lb charge the roof structure will experience significantly more than 380 psi reflected blast pressure. And this does not take into account the significant blast focusing effect of the receptacle. Pressures of this magnitude are certainly capable of destroying main structural members and causing catastrophic failure of the entire structure. As discussed in much of the literature on blast, the majority of fatalities are not caused by the direct effects of the blast wave on the human body but by the catastrophic failure of the structure that the victims occupy or by the violent translation caused to them. This was tragically illustrated by the bombing of Alfred P Murrah Building in Oklahoma City.

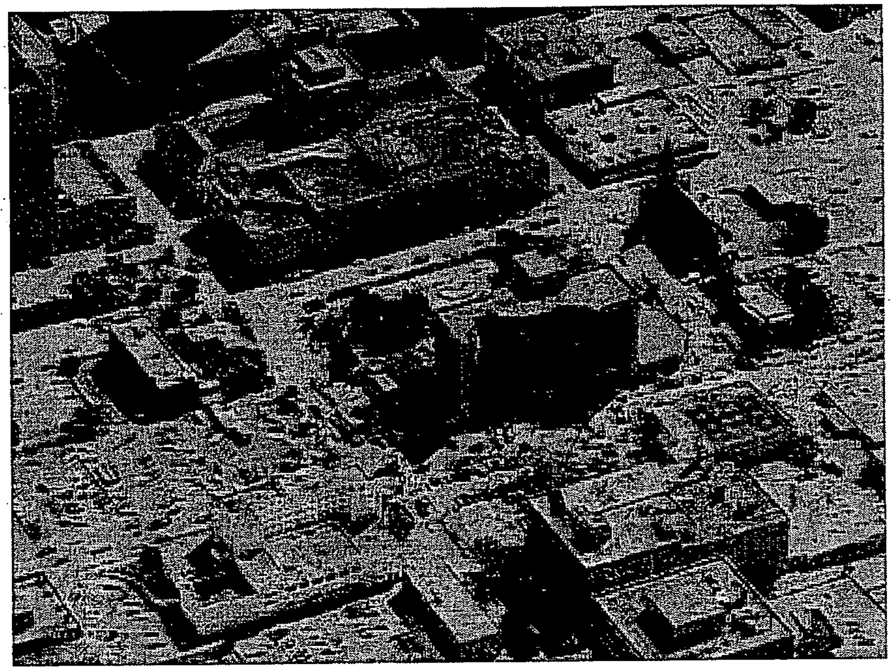

Fig 5: Aerial picture showing blast and structural damage to the Alfred P Murrah building, Oklahoma City.

Without going into detail in this note, it is worth pointing out that many buildings are extremely vulnerable to blast, and that catastrophic failure can result from a relatively minor explosive event. Blast must be managed if one is serious about saving lives in the event of an explosive attack.

Blast Management

So, what can be done? There are three accepted methods of effectively managing internal explosive blasts: total containment, controlled venting and blast mitigation.

With a total containment system the explosion would be contained within an extremely strong sealed system usually a steel cylinder or sphere fitted with a blast proof door. This kind of system is associated with a significant cost and mass penalty and as they will have to be closed to be effective, so they are of effectively no use as a trash receptacle.

Controlled venting utilizes the strong containment approach but manages the quasi-static pressure within the container by venting the highly pressurized hot gases/fireball out through vents of a carefully designed type and size. This system has mass and cost issues, and the vent size is unlikely to be appropriate for use as a trash receptacle.

Blast mitigation is an effective approach. Blast mitigants such as BlastWrap™ have been shown to reduce blast overpressure by as much as 97% with distance, and they are regularly used in reducing the effects of explosions. Testing has shown that, even for massive charges, BlastWrap™ reduces the blast pressure around the trash receptacle by more than 80% (85% for the MTR101 as measured during recent testing).

The driving factor in the development of a trash receptacle that can protect the public from the devastating effects of a terrorist bomb is not only whether the receptacle stays together under explosive loading but how the blast and fireball can be reduced to levels that are no longer a significant threat.

One further point on receptacle design: it is essential that in the event of the trash receptacle failing, that it fails in a safe mode. "Safe", in this case, means splitting down one side under excessive loading, but not fragmenting.

National Standards

Unfortunately, there are currently no official (US) standards with which vendors can comply when developing blast resistant trash receptacles. There are also no restrictions upon or guidelines for buyers when purchasing these products. These facts make it most important for buyers and sellers to exercise carefully considered judgments when purchasing and deploying these products.

Blast resistant trash receptacle manufacturers need to take these matters to heart. There are, however, standards that exist in other countries that define the method and threat for testing explosive proof bins (notably "Specification for Explosive Testing of Litter Bins" by Dr R. Lacey and M. J. Pettit of the UK Police Scientific Development Bureau). To obtain this report, access the Home Office website at:

http://www.homeoffice.gov.uk/crimpol/police/scidev/publications.html

The standard threat suggested within this note is a plastic explosive charge surrounded by various common trash items and steel balls to represent "worse case" fragmentation. The mass of the charge is defined by the trash receptacle manufacturer and indicates the charge size for which the unit is capable. For the US it is suggested that a 10lb (4.54Kg) bare charge of TNT, and a steel pipe bomb filled with 0.55lb (250g) smokeless powder represent credible test threats, since these are threats commonly seen throughout the world.

Now there is a unique opportunity to develop a thorough and credible specification for testing blast resistant trash receptacles. Importantly, it is also an excellent opportunity to challenge some of the dangerous claims that are being made in this field.

A beginning for this effort may look something like this:

"A blast resistant trash receptacle must be able to withstand an internal blast from a 10lb bare TNT charge detonated in three positions within the receptacle; center, sidewall (at the internal weld seam) and bottom. The bin must remain intact, and must produce no secondary fragmentation. It must not, in any way, increase the hazard from the explosive device. The bin must stop all of the primary fragmentation from a steel pipe bomb filled with 250g of smokeless powder or a standard military issue hand grenade (whichever is found to be the more severe threat). Blast pressures must be lower than potentially lethal beyond five feet from the edge of the bin. Flash and fireball must be extinguished within a few milliseconds." On this last point about thermal effects, we are of the opinion that a dramatically shortened "live fireball" will substantially reduce or eliminate the possibility of human skin burns below the 2 cal/cc^2, the point beyond which burns are no longer avoidable. Further testing to confirm this opinion will ensue.

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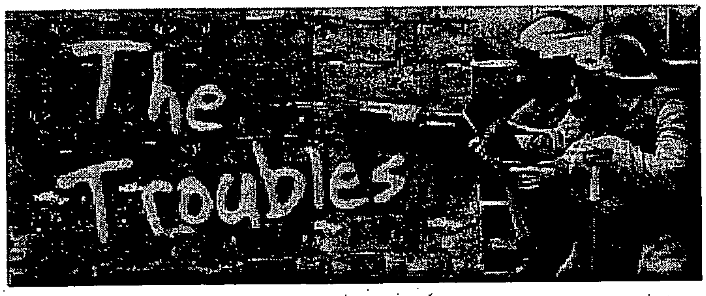

Principal Events

1969	
July	Civil rights march in Londonderry broken up by 'B Specials'
August	First British troops sent to Northern Ireland
1970	
June	Army imposes 24-hour curfew on Falls Road area, Belfast, conducts house-to-house search for terrorists; 5 people killed.
1971	
9 August	Internment without trial introduced
4 December	Protestant terrorists kill 15 Catholics with a bomb in a Londonderry bar
1972	
30 January	British paratroopers kill 13 Catholic demonstrators in Londonderry, on Bloody Sunday
22 February	IRA bomb in a bar in Aldershot, England kill 7 British soldiers
March	Stormont Parliament dissolved. Britain imposes direct rule on Northern Ireland
1973	
11 November	Power-sharing executive set up by Unionist, SDLP and Alliance parties
6-9 December	Conference at Sunningdale in England between British and Irish governments and the 3 parties. Agree to a 'Council of Ireland'.
1974	
May	Strike by protestant Ulster Worker's Council forces abandonment of executive and Sunningdale proposals
17 May	Car bombs in Dublin, planted by protestant terrorists, kill 22 people
5 October	Four soldiers and one civilian were killed and 65 were injured when two pubs were bombed in southern England.
21 November	IRA bombs in two pubs in Birmingham kill 21
1976	
4 January	5 Catholics murdered in County Armagh
5 January	10 protestant workers killed on a bus, in reprisal
21 July	British ambassador to Dublin killed by a bomb
1978	

17 February	IRA bombs at the Le Mon café, Belfast, kill 12
1979	
22 March	British ambassador to the Netherlands killed
30 March	Airey Neave, MP, killed by car bomb at the House of Commons
27 August	Bomb kills 18 British soldiers at Warrenpoint, Northern Ireland. Lord Louis Mountbatten and 3 others killed by bomb on his boat at Sligo, Ireland
1980	
October	First IRA prisoners' hunger strike. Called off 18 December
1981	
1 March	Bobby Sands begins hunger strike; he dies 5 May. 9 other IRA prisoners eventually starve themselves to death
1982	
22 July	11 British soldiers killed in two bombings in London, one under a bandstand in Regent's Park
6 December	Irish national Army bombs disco in Ballykelly, killing 11 soldiers and 6 civilians
1983	
17 December	Car bomb outside Harrods department store in London kills 5 people, wounds more than 80
1984	
12 October	IRA bomb in the Grand Hotel, Brighton, during the annual Tory party conference, kills 4, narrowly missing Margaret Thatcher
1985	
28 February	IRA mortar attack on police barracks at Newry kills 9 policemen in a cafeteria
15 november	Margaret Thatcher and Garrett Fitzgerald sign Anglo-Irish treaty
1987	
March	Gunfights between rival Republican terrorists kill 12
25 April	Ulster Chief Justice Maurice Gibson and his wife assassinated by a bomb
8 May	3 senior IRA men and 5 other terrorists killed in an ambush at Loughgall
8 november	11 civilians killed during an Armistice day service at Enniskillen
1988	
6 March	3 IRA terrorists shot by British SAS in Gibraltar
16 March	3 people killed by a protestant during the Gibraltar terrorists' funeral
19 March	2 British soldiers lynched during the funeral of the victims of the 16th March shooting
2 May	3 RAF men killed by bombs in Holland
15 June	6 British soldiers killed by car bomb at sports event
1 August	1 Soldier killed by bomb in army barracks in London
20 August	8 Soldiers travelling from Belfast airport killed by bomb
30 August	3 IRA gunmen killed by security forces

31 August	2 IRA suspects arrested crossing West german border from Holland, carrying explosives. Elderly Catholic couple killed by IRA booby-trap in Londonderry
12 September	Bombs demolish home of head of Northern Ireland civil service. Car bomb in belfast injures 12.
24 November	67-year-old Catholic and his 11-year-old granddaughter killed by IRA bomb; 8 other civilians wounded. As after 31st August bombing, and Enniskillen, the IRA apologizes.
1989	
14 March	18 policeman reprimanded in Northern Ireland for the death of five IRA suspects in 1982, in the shoot-to-kill or Stalker affair
8 September	German wife of British soldier shot in Germany
22 September	10 Royal Marines killed by bomb in Royal Marines School of Music, near Deal, Kent
19 October	Guildford Four released and convictions for the 1974 pub bomb overturned
26 October	RAF corporal and his six-month-old child killed by two IRA gunmen in Germany
1990	
12 January	4 IRA men arrested in florida trying to buy Stinger anti-aircraft missiles from undercover FBI agents
16, 20 June	Dutch police arrest 6 IRA terrorists involved in attacks on British troops in Germany
25 June	Bomb in Carlton Club, London, kills porter
20 July	Bomb in London Stock Exchange
30 July	Ian Gow, Tory MP and close friend of Prime Minister Thatcher, killed by a car bomb
19 September	IRA attempts to kill Sir Peter terry, in Staffordshire. he was governor of Gibraltar when teh 3 IRA terrorists were shot by police. he and his wife were wounded.
24 October	7 Killed, 37 wounded ins eries of proxy car bombings in northern Ireland. hostages were forced to drive cars with bombs in them at terrorists' targets
1991	
7 February	IRA squad launches mortar attack on 10 Downing Street from Whitehall, no casualties.
18 February	Bombs exploded in Paddington and victoria stations, London. One killed.
14 March	Birmingham Six freed after 16 years in jail; courts ruled their confessions were 'unsafe and unsatisfactory'
30 April	Preliminary talks open at Stormont between Protestant and Catholic parties and British on power sharing
1 June	3 Soldiers killed by car bomb attack on army base at Glenanne, Armagh
2 June	Senior civil servant, a woman loses both legs in bomb attack; IRA apologizes
3 June	3 IRA gunmen killed by police in ambush 30 miles west of Belfast
17 June	Round-table talks on future of Northern Ireland open in Stormont
3 July	Stormont talks abandoned because of protestant intransigence
13 November	IRA shoots 4 men in Belfast, claiming they were members of protestant death-squads. Another man and six-week-old baby wounded.
15	

November	Two terrorist, a man and a woman, blow themselves up with their own bomb in St Albans
1 December	Firebombs set off against shops in London
December	Car bomb severely damages Belfast opera house and Europe hotel
1992	
6 January	2 car bombs do great damage to centre of Belfast, and a firebomb set off in Oxford
10 January	Bomb in whitehall damages government buildings

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